

Title (en)
VERTICAL EMISSION CASCADE LASERS

Title (de)
KASKADENLASER MIT VERTIKALER EMISSION

Title (fr)
LASERS EN CASCADE À ÉMISSION VERTICALE

Publication
EP 4246741 A1 20230920 (EN)

Application
EP 22162017 A 20220315

Priority
EP 22162017 A 20220315

Abstract (en)
A vertical emission cascade laser (10) comprising an in-plane waveguide formed by a lower cladding layer (14), active region layers (15) and an upper cladding layer (16). A disk-shaped side surface (33) laterally bounds the in-plane waveguide and has a mirror layer (39) arranged over it to form a cavity capable of supporting multiple radial modes. An in-plane grating structure (28; 28, 29) of concentric rings is formed in one of the cladding layers (14, 16), the grating structure functioning both to select one of the multiple radial cavity modes for lasing and also to couple out the laser light through the lower and/or upper cladding layer (14, 16). The grating structure includes at least a higher order grating portion of order $m \geq 2$ and optionally also a first order grating portion with $m = 1$.

IPC 8 full level
H01S 5/187 (2006.01); **H01S 5/028** (2006.01); **H01S 5/34** (2006.01); **H01S 5/12** (2021.01)

CPC (source: EP)
H01S 5/028 (2013.01); **H01S 5/187** (2013.01); **H01S 5/3402** (2013.01); **H01S 5/0282** (2013.01); **H01S 5/0287** (2013.01); **H01S 5/1203** (2013.01); **H01S 5/1215** (2013.01); **H01S 5/3422** (2013.01)

Citation (applicant)
• US 2019074663 A1 20190307 - SAITO SHINJI [JP], et al
• M. J. SUESS ET AL.: "Single-Mode Quantum Cascade Laser Array Emitting From a Single Facet", IEEE PHOTONICS TECHNOLOGY LETTERS, vol. 28, no. 11, 1 June 2016 (2016-06-01), pages 1197 - 1200, XP011605313, Retrieved from the Internet <URL:https://doi.org/10.1109/LPT.2016.2533443> DOI: 10.1109/LPT.2016.2533443
• R. SZEDLAKC. SCHWARZERT. ZEDERBAUERH. DETZA. ANDREWSW. SCHRENGK. STRASSER: "Grating-based far field modifications of ring quantum cascade lasers", OPT. EXPRESS, vol. 22, 2014, pages 15829 - 15836, Retrieved from the Internet <URL:https://doi.org/10.1364/OE.22.015829>
• MAHLER, L.TREDICUCCI, A.BELTRAM, F. ET AL.: "Vertically emitting microdisk lasers", NATURE PHOTON, vol. 3, 2009, pages 46 - 49, Retrieved from the Internet <URL:https://doi.org/10.1038/nphoton.2008.248>
• G. LIANGH. LIANGY. ZHANGL. LIA. DAVIESE. LINFIELD. YUH. LIUQ. WANG: "Low divergence single-mode surface-emitting concentric-circular-grating terahertz quantum cascade lasers", OPT. EXPRESS, vol. 21, 2013, pages 31872 - 31882, Retrieved from the Internet <URL:https://doi.org/10.1364/OE.21.031872>
• KAPSALIDIS, F.SHAHMOHAMMADI, M.SUESS, M.J. ET AL.: "Dual-wavelength DFB quantum cascade lasers: sources for multi-species trace gas spectroscopy", APPL. PHYS., vol. 124, 2018, pages 107, Retrieved from the Internet <URL:https://doi.org/10.1007/s00340-018-6973-2>
• WU, D. H.RAZEGHI, M.: "High power, low divergent, substrate emitting quantum cascade ring laser in continuous wave operation", APL MATERIALS, vol. 5, 2017, pages 035505, XP012217340, Retrieved from the Internet <URL:https://doi.org/10.1063/1.4978810> DOI: 10.1063/1.4978810

Citation (search report)
• [Y] EP 3457506 A1 20190320 - TOSHIBA KK [JP]
• [Y] US 2013016749 A1 20130117 - MOTODA TAKASHI [JP]
• [A] US 2009147818 A1 20090611 - BAUMANN KRISTIAN GOTTHOLD [DE], et al
• [A] HOLZBAUER MARTIN ET AL: "Substrate-emitting ring interband cascade lasers", APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS, 2 HUNTINGTON QUADRANGLE, MELVILLE, NY 11747, vol. 111, no. 17, 26 October 2017 (2017-10-26), XP012223154, ISSN: 0003-6951, [retrieved on 20171026], DOI: 10.1063/1.4989514

Designated contracting state (EPC)
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Designated extension state (EPC)
BA ME

Designated validation state (EPC)
KH MA MD TN

DOCDB simple family (publication)
EP 4246741 A1 20230920; WO 2023174573 A1 20230921

DOCDB simple family (application)
EP 22162017 A 20220315; EP 2022086175 W 20221215